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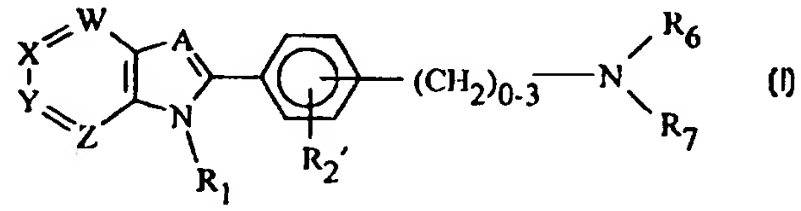

(I)

(57) Abstract

Benzimidazole derivatives of formula (I) or a pharmaceutically acceptable salt thereof are MCP-1 antagonists and are thus useful in the treatment of inflammation, artherosclerosis, restenosis, and immune disorders such as arthritis and transplant rejection wherein A is N or CH; where W, X, Y and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N; no more than two of W, X, Y and Z can be N in any one structure, R_2, R_3, R_4 and R_5 can be independently H, $C_{1\text{-}20}$ alkyl, halogen, nitro, -$SO_2NR_8R_9$, alkoxy of from 1-4 carbon atoms; -$S(O)_pR$ where p is an integer from 0 to 2; -$(CH_2)_mOR$, -$(CH_2)_mCOOR$, -$(CH_2)_mNR_8R_9$, -$(CH_2)_mCONR_8R_9$, -$(CH_2)_mCOR$, or -CF_3; m is an integer of from 0 to 4, R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl; R_1 can be H, lower alkyl of from 1-4 carbon atoms, or -$(CH_2)_m$-Ph; R_6 is alkyl of from 1-6 carbon atoms or R_7; R_7 is $(CH_2)_nNR_{10}R_{11}$; n is an integer from 2 to 6; R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms, or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12}; R_{10} and R_{11} can independently be lower alkyl, -$(CH_2)_m$Ph, unsubstituted or substituted with up to three R_2 substituents, or R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12}; R_{12} is hydrogen, lower alkyl, -$(CH_2)_t$Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents; t is an integer of from 0 to 2.

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2-PHENYL BENZIMIDAZOLE DERIVATIVES AS MCP-1 ANTAGONISTS

FIELD OF THE INVENTION

The present invention relates to novel compounds and medical methods of treatment of inflammation, atherosclerosis, restenosis, and immune disorders especially those associated with lymphocyte or monocyte accumulation such as arthritis and transplant rejection. More particularly, the present invention concerns the use of 2-phenyl benzimidazole derivatives.

BACKGROUND OF THE INVENTION

Migration of leukocytes from blood vessels into diseased tissues is important to the initiation of normal disease-fighting inflammatory responses. But this process, known as leukocyte recruitment, is also involved in the onset and progression of debilitating and life-threatening inflammatory and autoimmune diseases. The pathology of these diseases results from the attack of the body's immune system defenses on normal tissues. Thus, blocking leukocyte recruitment to target tissues in inflammatory and autoimmune disease would be a highly effective therapeutic intervention. The leukocyte cell classes that participate in cellular immune responses include lymphocytes, monocytes, neutrophils, eosinophils and basophils. In many cases, lymphocytes are the leukocyte class that initiates, coordinates, and maintains chronic inflammatory responses, and thus are generally the most important class of cells to block from entering inflammatory sites. Lymphocytes attract monocytes to the site, which, collectively with lymphocytes, are responsible for much of the actual tissue damage that occurs in inflammatory disease. Infiltration of lymphocytes and/or monocytes is responsible for a wide range of chronic, autoimmune diseases, and also organ transplant rejection. These diseases include, but are not limited to, rheumatoid arthritis, atherosclerosis, psoriasis, chronic contact dermatitis, inflammatory bowel disease, multiple sclerosis, sarcoidosis, idiopathic pulmonary fibrosis,

dermatomyositis, skin pemphigoid and related diseases, (e.g., pemphigus vulgaris, p. foliacious, p. erythematosis), glomerulonephritides, vasculitides, hepatitis, diabetes, allograft rejection, and graft-versus-host disease.

This process, by which leukocytes leave the bloodstream and accumulate at inflammatory sites, and initiate disease, takes place in at least three distinct steps which have been described as (1) rolling, (2) activation/firm adhesion and (3) transendothelial migration [Springer, T.A., Nature 346:425-433 (1990); Lawrence and Springer, Cell 65:859-873 (1991); Butcher, E.C., Cell 67:1033-1036 (1991)]. The second step is mediated at a molecular level by chemoattractant receptors. Chemoattractant receptors on the surface of leukocytes bind chemoattractant cytokines secreted by cells at the site of damage or infection. Receptor binding activates leukocytes, increases the adhesiveness of the adhesion molecules that mediate transendothelial migration, and promotes directed migration of the cells toward the source of the chemoattractant cytokine.

A recent discovery is the existence of a large family (>20 members) of structurally homologous chemoattractant cytokines, approximately 8 to 10 kD in size. These molecules share the ability to stimulate directed cell migration (chemotaxis) and have been collectively called "chemokines", a contraction of chemotactic cytokines. Each chemokine contains four cysteine residues (C) and two internal disulfide bonds. Chemokines can be grouped into two subfamilies, based on whether the two amino terminal cysteine residues are immediately adjacent (C-C family) or separated by one amino acid (C-X-C family). These differences correlate with the organization of the two subfamilies into separate gene clusters. Within each gene cluster, the chemokines typically show sequence similarities between 25 to 60%.

The chemokines of the C-X-C subfamily, such as interleukin-8, are produced by a wide range of cell types and act predominantly on neutrophils as mediators of acute inflammation. Chemokines of the C-C subfamily are also produced by a wide variety of cell types. These molecules act predominantly on subsets of mononuclear inflammatory cells. Currently there are at least six C-C chemokines with known chemotactic activity for human monocytes and/or T cells, including MCP-1, MCP-2, MCP-3, MIP-1α, MIP-1β, and RANTES. This

suggests there may be a high degree of redundancy in chemoattractant pathways. In addition, most C-C chemokines are chemotactic for more than one cell type. For examples, RANTES (regulated on activation, normal T cell expressed and secreted) acts on memory $CD4^+$ T cells, eosinophils, and monocytes. Monocyte chemoattractant protein-1 (MCP-1), another C-C chemokine, acts on monocytes, activated "memory" T cells and on basophils. MCP-1 is also a potent secretogogue of inflammatory mediators for monocytes and basophils.

Five C-C chemokine receptors have recently been characterized (CKR1-5 or CCR1-CCR5), and all of these belong to the seven transmembrane spanning G protein-coupled receptor family. Each of these receptors mediates the binding and signaling of more than one chemokine. For example, the CCR1 receptor binds both MIP-1α and RANTES. There are 2 receptors which bind MCP-1, CCR2 (with alternately spliced forms, 2A and 2B) and CCR4. CCR2 is also known to mediate binding and signaling of MCP-3. The CCR4 receptor binds and signals, in addition to MCP-1, with RANTES and MIP-1α. Which of these is responsible for the MCP-1 mediated recruitment of monocytes and T cells is not known.

In agreement with the observation that lymphocyte emigration into inflammatory sites is usually accompanied by emigration of monocytes, MCP-1 is expressed at sites of antigen challenge and autoimmune disease. However, analyses of human inflammatory lesions with antibodies to other chemokines show RANTES, MIP-1α, MIP-1β and MCP-3 to be present as well. Injection of MCP-1 into skin sites in mice provokes only a mild monocytic infiltrate or no infiltrate at all (Ernst, C.A. et al., J. Immunol. 152:3541-3544, 1994). Whether these results reflect redundant and complex recruitment pathways has not been resolved. MCP-1 and MCP-3 may play a role in allergic hypersensitivity disease. This is suggested by the observation that MCP-1 lacking the amino terminal glutamic acid loses the ability to stimulate basophil mediator release and acquires activity as an eosinophil chemoattractant.

Chemokines of both subfamilies may bind to heparan sulfate proteoglycans on the endothelial cell surface, and may function principally to stimulate haptotaxis of leukocytes that attach to cytokine-activated endothelium through induced adhesion molecules. Additionally, MCP-1 has been reported to

selectively activate the β1 integrin family of leukocyte adhesion molecule, suggesting a role in leukocyte interactions with the extracellular matrix. Hence, MCP-1 may not only trigger the initial arrest and adhesion of monocytes and T cells, but may also act to guide their migration in extravascular space.

Chemoattractants appear to be required for transendothelial migration in vitro and in vivo and can induce all steps required for transmigration in vivo. Injection of neutrophil chemoattractants into skin or muscle leads to robust emigration of neutrophils from the vasculature and accumulation at the injection site (Colditz, 1991). Pretreatment of neutrophils with pertussis toxin inhibits emigration into inflammatory sites (Spangrude, et al., 1985; Nourshargh and Williams, 1990). Moreover, MAb to IL-8 markedly inhibits neutrophil emigration in inflammation (Sekido et al., 1993).

Neutrophil chemoattractants injected into the same skin site hours apart will stimulate neutrophil accumulation the first time but not the second time, whereas a second injection into a distant site will stimulate accumulation at that site. This desensitization occurs for homologous chemoattractants only (Colditz, 1991) or those that interact with the same receptor. Thus, chemoattractants can act on and homologously desensitize a cell type that is localized in tissue.

Chemoattractants impart directionality to leukocyte migration. By contrast with intradermal injection, intravascular injection of IL-8 does not lead to emigration (Hechtman et al., 1991). Cytokine-stimulated endothelial monolayers grown on filters secrete IL-8 into the underlying collagen layer. Neutrophils added to the apical compartment emigrate into the basilar compartment, but not when the IL-8 gradient is disrupted by addition of IL-8 to the apical compartment (Huber et al., 1991).

The endothelium may present chemoattractants to leukocytes in a functionally relevant way, as well as providing a permeability barrier that stabilizes the chemoattractant gradient. Since leukocytes, responding to specific antigen or inflammatory signals in tissue, may signal emigration of further leukocytes into the site, a chemoattractant was sought in material secreted by mitogen-stimulated mononuclear cells (Carr et al., 1994). Purification to homogeneity guided by a transendothelial lymphocyte chemotaxis assay revealed

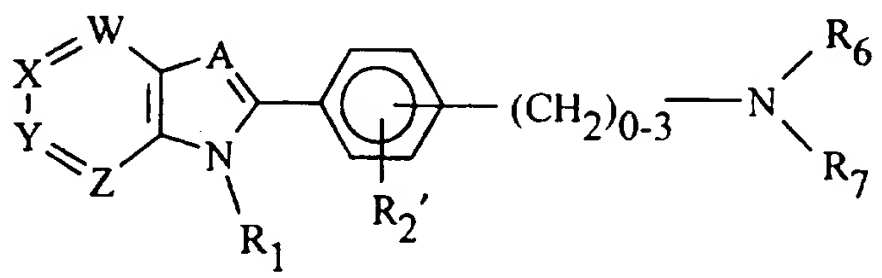
that monocyte chemoattractant protein 1 (MCP-1), previously thought to be solely a monocyte chemoattractant, is a major lymphocyte chemoattractant. An activated subset of memory lymphocytes respond to MCP-1. In the same assay, lymphocytes respond to RANTES and MIP-1α but less so than to MCP-1 (C-C chemokines) and not at all to IL-8 or IP-10 (C-X-C chemokines). This physiologically relevant assay suggests that C-C chemokines tend to attract both monocytes and lymphocytes. In agreement with the observation that lymphocyte emigration into inflammatory sites is accompanied by emigration of monocytes, MCP-1 is abundantly expressed at sites of antigen challenge and autoimmune disease (Miller and Krangel, 1992) and, together with other chemokines, is an excellent candidate to provide the step 2 signal required to activate integrin adhesiveness and emigration of lymphocytes in vivo. (Traffic Signals for Lymphocyte Recirculation and Leukocyte Emigration: The Multistep Paradigm; Springer, 1994, Cell 76: 301-314).

We have surprisingly found that 2-phenyl benzimidazole derivates are MCP-1 receptor antagonists and are capable of inhibiting the binding of MCP-1 to its receptor. Surprisingly, the compounds block T cell migration *in vitro*, and more surprisingly still, have dramatic effects on the recruitment of inflammatory cells in multiple models of inflammatory diseases. Thus, these compounds are useful as agents for the treatment of inflammatory disease, especially those associated with lymphocyte and/or monocyte accumulation, such as arthritis, atherosclerosis and transplant rejection. In addition, these compounds can be used in the treatment of allergic hypersensitivity disorders such as asthma and allergic rhinitis characterized by basophil activation and eosinophil recruitment, as well as for the treatment of restenosis and chronic or acute immune disorders.

SUMMARY OF THE INVENTION

Accordingly, a first embodiment of the present invention provides a method of treatment of chronic or acute inflammatory disease, atherosclerosis, restenosis, chronic or acute immune disorders, and transplant rejection in

mammals in need thereof comprising administering to such mammal an effective amount of a 2-phenyl benzimidazole of Formula I or a pharmaceutically acceptable salt thereof:



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N, no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ where p is an integer of from 0 to 2,

$-(CH_2)_mOR$,

$-(CH_2)_mCOOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$,

$-CF_3$,

-benzyl, or

phenyl wherein benzyl or phenyl is optionally substituted with one or two substituents each independently selected from alkyl, halogen, hydrogen, hydroxy, or alkoxy;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms or benzyl;

when X and Y are substituted by alkyl, they can be joined to form a ring fused at X and Y;

R_1 is H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R'_2 is:

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ wherein p is an integer of from 0 to 2,

$-(CH_2)_mOR_1-CH_2COOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

R_6 is hydrogen, alkyl of from 1 to 6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents,

or

R_{10} and R_{11} can be taken together to form a ring of from 3 to 8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents;

t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

A still further and second embodiment of the present invention is a method of treatment of atherosclerosis in mammals in need thereof comprising administering to such mammal an effective amount of a compound selected from the group consisting of: a compound of Formula I in combination with one or more agents selected from the group consisting of:

(a) ACAT inhibitor;

(b) HMG-CoA reductase inhibitor;

(c) Lipid regulator; and

(d) Bile acid sequestrant;

or a pharmaceutically acceptable salt thereof.

Also, the invention is directed to inhibiting the binding of MCP-1 by utilizing an effective inhibiting amount of a compound of Formula I.

Also, the invention is directed to the novel compositions of Formula I.

Finally, the present invention is directed to a pharmaceutical composition for administering an effective amount of a compound of Formula I in unit dosage form in the treatment methods mentioned above.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 shows the dose response of Example 1 in a rat glucan vasculitis assay.

Figure 2 is a graphic illustration of the degree of inhibition of T cell recruitment in rat DHR over a 24 hour period at various doses of Compound 1. There was a statistically significant inhibitory effect of the compound when administered at 30 and 23 mg/kg *per os* at the time of antigen challenge.

DETAILED DESCRIPTION OF THE INVENTION

In the compounds of Formula I, the term "lower alkyl" means a straight or branched hydrocarbon radical having from 1 to 4 carbon atoms and includes, for example, methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, isobutyl, or tert-butyl.

The term "lower alkoxy" is O-alkyl as defined above for lower alkyl.

"Halogen" is fluorine, chlorine, bromine, or iodine.

Preferably, heterocycle is five or six-membered mono or bicyclic ring structures which may contain one or more heteroatom such as N or O; examples of heterocycle are pyridine, pyrimidine, pyridazine, pyrazole, oxazole, indole, N-alkylindole, quinoline, quinazoline, quinazolinone and the like. Substituents can be hydrogen, alkyl of from 1-4 carbon atoms; cycloalkyl of from 5-7 carbon atoms, OR_1, SR_1, $-NR_8R_9$, $(CH_2)_n-NR_8R_9$, $-COOR_1$, $-CH_2OR_1$, $-CONR_8R_9$, $-COR_1$, $-CH_2CONR_8R_9$, $SO_2NR_8R_9$, $NHCOR_1$, $NR_1\ CONR_8$ where R_1, R_8 and R_9 are as defined above; -CN, or halogen.

The term "mammal" includes animals and humans.

Some of the compounds of Formula I are capable of further forming both pharmaceutically acceptable acid addition and/or base salts. All of these forms are within the scope of the present invention.

Pharmaceutically acceptable acid addition salts of the compounds of Formula I include salts derived from nontoxic inorganic acids such as hydrochloric, nitric, phosphoric, sulfuric, hydrobromic, hydriodic, hydrofluoric, phosphorous, and the like, as well as the salts derived from nontoxic organic acids, such as aliphatic mono- and dicarboxylic acids, 2-phenyl-substituted alkanoic acids, hydroxy alkanoic acids, alkanedioic acids, aromatic acids, aliphatic and

aromatic sulfonic acids, etc. Such salts thus include sulfate, pyrosulfate, bisulfate, sulfite, bisulfite, nitrate, phosphate, monohydrogenphosphate, dihydrogenphosphate, metaphosphate, pyrophosphate, chloride, bromide, iodide, acetate, trifluoroacetate, propionate, caprylate, isobutyrate, oxalate, malonate, succinate, suberate, sebacate, fumarate, maleate, mandelate, benzoate, chlorobenzoate, methylbenzoate, dinitrobenzoate, phthalate, benzenesulfonate, toluenesulfonate, phenylacetate, citrate, lactate, maleate, tartrate, methanesulfonate, and the like. Also contemplated are salts of amino acids such as arginate and the like and gluconate, galacturonate (see, for example, Berge S.M., et al., "Pharmaceutical Salts," J. Pharma. Sci., 1977;66:1).

The acid addition salts of said basic compounds can be prepared by contacting the free base form with a sufficient amount of the desired acid to produce the salt in the conventional manner. The free base form may be regenerated by contacting the salt form with a base and isolating the free base in the conventional manner. The free base forms can differ from their respective salt forms somewhat in certain physical properties such as solubility in polar solvents.

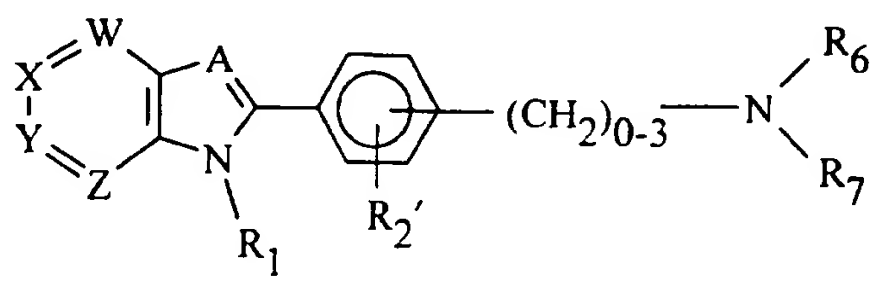
Pharmaceutically acceptable base addition salts can be formed with metals or amines, such as alkali and alkaline earth metals or organic amines. Examples of such metals used as cations are sodium, potassium, magnesium, calcium, and the like. Examples of suitable amines are N,N'-dibenzylethylenediamine, chloroprocaine, choline, diethanolamine, dicyclohexylamine, ethylenediamine, N-methylglucamine, and procaine (see Berge, Supra, 1977).

The base addition salts of said acidic compounds can be prepared by contacting the free acid form with a sufficient amount of the desired base to produce the salt in the conventional manner. The free acid form may be regenerated by contacting the salt form with an acid and isolating the free acid in the conventional manner. The free acid forms can differ from their respective salt forms somewhat in certain physical properties such as solubility in polar solvents.

Certain of the compounds of the present invention can exist in unsolvated forms as well as solvated forms, including hydrated forms and are intended to be encompassed within the scope of the present invention.

Certain of the compounds of the present invention possess one or more chiral centers and each center may exist in the R(D) or S(L) configuration. The present invention includes all enantiomeric and epimeric forms as well as the appropriate mixtures thereof.

A preferred compound of the first embodiment used in the method of the present invention is a compound Formula I of:



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N;

no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} alkyl,

halogen,

nitro,

-$SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms;

-$S(O)_pR$ where p = 0-2;

-$(CH_2)_mOR$,

-$(CH_2)_mCOOR$,

-$(CH_2)_mNR_8R_9$,

-$(CH_2)_mCONR_8R_9$,

-$(CH_2)_mCOR$, or

-CF_3,

-benzyl, or

phenyl wherein benzyl or phenyl is optionally substituted with one or two substituents each independently selected from alkyl, halogen, hydrogen, hydroxy, or alkoxy;

when X and Y are substituted by alkyl, they can be joined to form a ring fused at X and Y;

m is an integer of from 0-4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms (such as phenyl or naphthyl) or benzyl;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms or can be taken together to form a ring of from 3-8 atoms containing up to one additional heteroatom as oxygen, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_t$ Ph, unsubstituted or substituted with up to three R_2 substituents,

or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

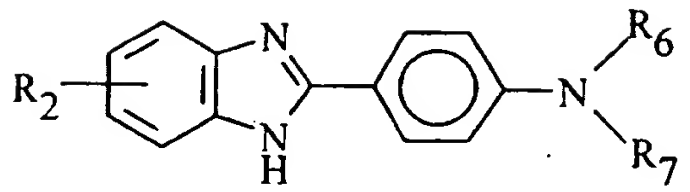
lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl, unsubstituted or substituted with up to three R_2 substituents;

t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

Examples of preferred benzimidazoles are as follows:



and they are as described above for Formula I.

A benzimidazole compound can be administered to a mammal (e.g., a human) alone or in conjunction with (before, along with or subsequent to) one or more other benzimidazole compounds or another agent to be administered.

Preferred compounds used in the second embodiment of the present invention include one or more agents selected from the group consisting of an acyl CoA:cholesterol acyltransferase (ACAT) inhibitor; 3-hydroxy-3-methyglutaryl-coenzyme A reductase (HMG-CoA reductase) inhibitor; lipid regulator; and bile acid sequestrant.

Examples of ACAT inhibitors include DL-melinamide disclosed in British Patent 1,123,004 and Japan. J. Pharmacol., 1986;42:517-523; 2,2-dimethyl-N-(2,4,6-trimethoxyphenyl)dodecanamide disclosed in U.S. Patent 4,716,175; N-[2,6-bis(1-methylethyl)phenyl]-N′-[[1-(4-dimethylaminophenyl)cyclopentyl]-methyl]urea disclosed in U.S. Patent 5,015,644; 2,6-bis(1-methylethyl)-phenyl[[2,4,6-tris(1-methylethyl)phenyl]acetyl]sulfamate disclosed in copending U.S. Patent Application Serial Number 08/233,932 filed April 13, 1994; and the like. U.S. Patents 4,716,175 and 5,015,644 and U.S. Patent Application Serial Number 08/233,932 and British Patent 1,123,004 and Japan. J. Pharmacol., 1986;42:517-523 are hereby incorporated by reference.

Examples of HMG-CoA reductase inhibitors include lovastatin disclosed in U.S. Patent 4,231,938; pravastatin disclosed in U.S. Patent 4,346,227; simvastatin disclosed in U.S. Patent 4,444,784; fluvastatin disclosed in U.S. Patent 4,739,073; atorvastatin disclosed in U.S. Patents 4,681,893 and 5,273,995; and the like. U.S. Patents 4,231,938; 4,346,227; 4,444,784; 4,681,893; 4,739,073 and 5,273,995 are hereby incorporated by reference.

Examples of bile acid sequestrants include colestipol disclosed in U.S. Patents 3,692,895 and 3,803,237; cholestyramine disclosed in U.S. Patent 3,383,281 and Casdorph R. in Lipid Pharmacology., 1976;2:222-256, Paoletti C.,

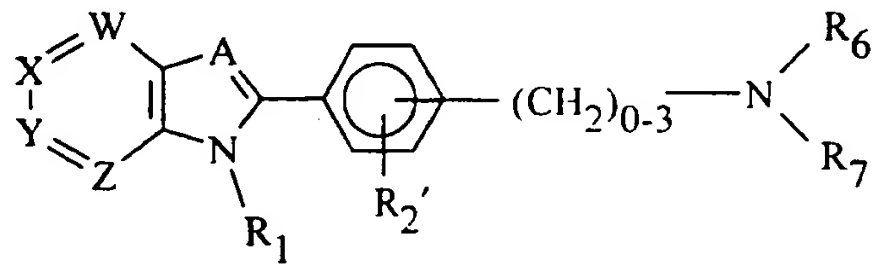
Glueck J., eds. Academic Press, NY; and the like. U.S. Patents 3,692,895; 3,803,237 and 3,383,281 and R. Casdorph, supra, 1976, are hereby incorporated by reference.

Examples of lipid regulators include gemfibrozil described in U.S. Patent 3,674,836; bezafibrate disclosed in U.S. Patent 3,781,328; clofibrate disclosed in U.S. Patent 3,262,850; fenofibrate disclosed in U.S. Patent 4,058,552; niacin disclosed in McElvain, et al., Org. Syn., 1925;4:49; and the like. U.S. Patents 3,674,836; 3,781,328; 3,262,850 and 4,058,552 and McElvain, et al., Org. Syn., 1925;4:49 are hereby incorporated by reference.

Methods of preparing ACAT inhibitors, HMG-CoA reductase inhibitors, lipid regulators, and bile acid sequestrants used in the second embodiment of the present invention are disclosed in the aforementioned references.

The invention is also concerned with novel compounds as benzimidazole derivatives:

A compound of Formula I



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N, no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms;

-$S(O)_pR$ where p is an integer of from 0 to 2;

-$(CH_2)_mOR$,

-$(CH_2)_mCOOR$,

-$(CH_2)_mNR_8R_9$,

-$(CH_2)_mCONR_8R_9$,

-$(CH_2)_mCOR$, or

-CF_3;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or -$(CH_2)_m$-Ph;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

-$(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents,

or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

lower alkyl,

-$(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents;

t is an integer of from 0 to 2;

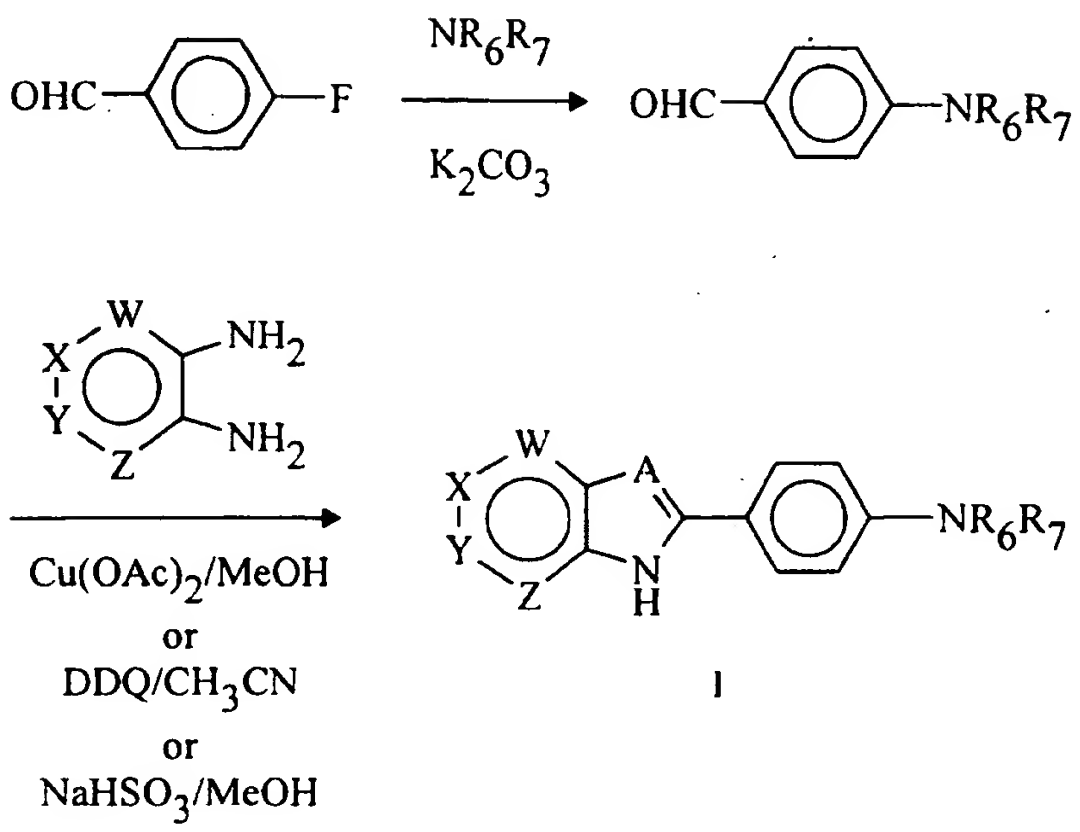
or a pharmaceutically acceptable salt thereof.

General Synthesis:

Compounds of Formula I can be synthesized as follows:

SCHEME A

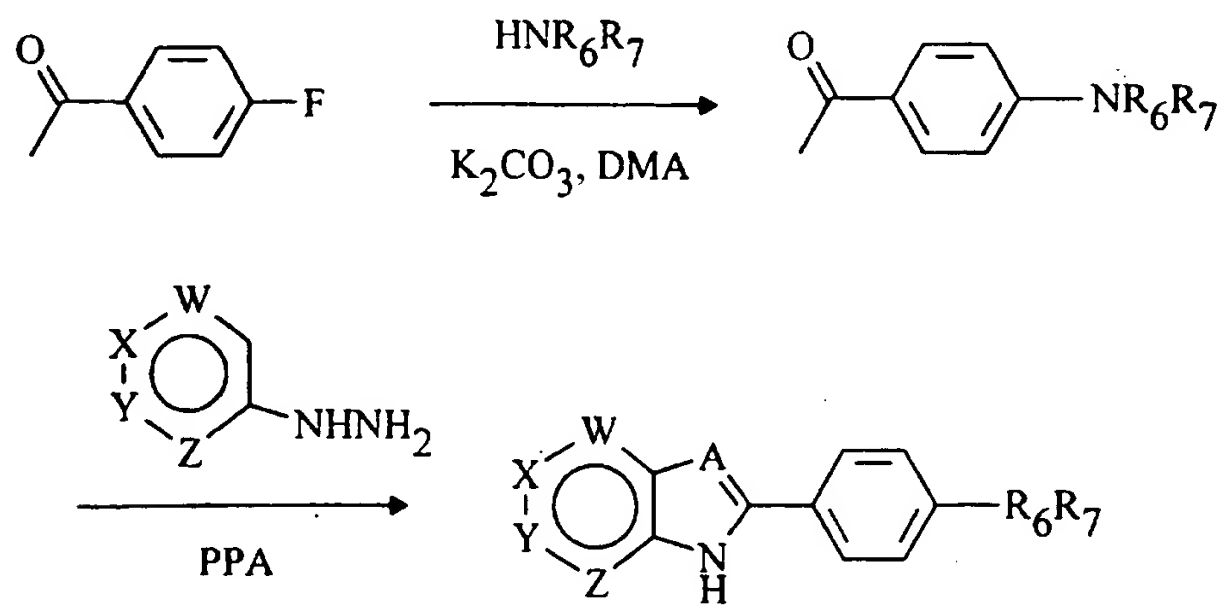
Where A is N



I

DDQ means 2,3-dichloro-5,6-dicyanobenzoquinone.

Where A is CH



The benzimidazoles are valuable agents for the treatment of inflammatory diseases or conditions, atherosclerosis, restenosis, and autoimmune disorders such as arthritis and transplant rejection.

In a preferred embodiment, the disease or condition is one which is associated with lymphocyte and/or monocyte infiltration of tissues (including recruitment and/or accumulation in tissues), such as arthritis (e.g., rheumatoid arthritis), inflammatory bowel diseases (e.g., Crohn's disease, ulcerative colitis), multiple sclerosis, idiopathic pulmonary fibrosis, and graft rejection (e.g., in transplantation), including allograft rejection or graft-versus-host disease. In addition, diseases characterized by basophil activation and/or eosinophil recruitment, including allergic hypersensitivity disorders such as asthma and allergic rhinitis can be treated according to the present invention.

Other diseases that may be treated with the benzimidazole of Formula I are: psoriasis, chronic contact dermatitis, sarcoidosis, dermatomyositis, skin phemphigoid and related diseases (e.g., pemphigus vulgaris, p. foliacious, p. erythematosus), glomerulonephritides, vasculitides (e.g., necrotizing, cutaneous, and hypersensitivity vasculitis), hepatitis, diabetes, systemic lupus erythematosus and myasthenia gravis.

In addition to psoriasis, other inflammatory dermatoses such as dermatitis, eczema, atopic dermatitis, allergic contact dermatitis, urticaria and reperfusion injury can also be treated.

MCP-1 BINDING ASSAY

Membranes used in the MCP-1 binding assay were prepared from THP-1 cells (human monocytic cell line source - American Type Culture Collection, Tumor Immunology Bank #202, Rockville, MD, accession no. ATCC TIB 202). Cells were harvested by centrifugation and washed twice in ice-cold PBS (phosphate-buffered saline) and the cell pellet was frozen at -80°C in some cases. Cells were resuspended in ice-cold lysis buffer 5mM HEPES (2-(4N-[2-hydroxyethyl]piperazin-1-yl)-N′-(2-ethanesulfonic acid), pH 7.5, 2 mM EDTA (ethylenediaminetetraacetic acid), 5 µg/mL each leupeptin, aprotinin, chymostatin

(protease inhibitors), and 100 µg/mL PMSF (phenylmethane sulfonyl fluoride - also a protease inhibitor)) at a concentration of 5×10^7 cells/mL. The cell suspension was dounced 10-15 times using the B pestle (small pestle of tissue grinder - clearance is 0.07 mm; source - Fisher Scientific) on ice. Nuclei and debris were removed by centrifugation at 500-1000 × g for 10 minutes at 4°C. The supernatant was transferred to a fresh tube and centrifuged at 25,000 × g for 30 minutes at 4°C. The supernatant was aspirated and the pellet was resuspended in freezing buffer (10 mM HEPES, pH 7.5, 300 mM sucrose, 1 µg/mL each leupeptin, aprotinin, chymostatin, and 10 µg/mL PMSF) using a minihomogenizer until all clumps were resolved. Membranes were aliquoted and frozen at minus 70-85°C until needed. Typical binding assays used 10-20 µg/well of total membrane protein as determined with a standard protein assay (e.g. Bradford protein assay, BioRad, Richmond, CA).

For binding, 10-20 µg of total membrane protein were included in the binding reaction along with 0.2 nM I^{125}-labeled MCP-1 (Amersham, Arlington Heights, IL) with or without unlabeled competitor MCP-1 (Peprotech, Rocky Hill, NJ) (at 500 nM). Binding reactions were performed in a final volume of 100 ul in a binding buffer containing 10 mM HEPES, pH 7.2, 1 mM $CaCl_2$, 5 mM $MgCl_2$, 0.5% BSA (bovine serum albumin). After 30-60 minutes at room temperature, the binding reactions were filtered through GF/C filters (Whatman glass fiber filters, Type C) or GF/B unifilter plates (Packard) which had been pre-soaked with 0.3% polyethyleneimine and washed twice with binding buffer containing 0.5 M NaCl. Filters were dried and counted in a Beta-Plate scintillation counter using standard scintillation fluid. Final concentration of compound in the binding assay ranged from 0.05-100 µM. Compounds were dissolved in DMSO (dimethyl sulfoxide). Final concentrations of DMSO in the binding were kept constant at 0.5%.

IC50s were calculated using a non-linear 3-parameter logistic curve fit. IC50 means the concentration at which 50% inhibition is achieved. Negative controls contained the same amount of DMSO vehicle as used in wells containing compound. Positive control contained 250-500 nM cold competitor MCP-1 in

DMSO vehicle. Non-specific binding (the level of bound ^{125}I-labeled MCP-1 in the presence of 250-500 μM unlabeled MCP-1) was subtracted from all data prior to analysis.

The data in the table below show the MCP-receptor binding activity of representative benzimidazoles of the present invention.

TABLE 1. Biological Activity: MCP-1 Receptor Binding Assay

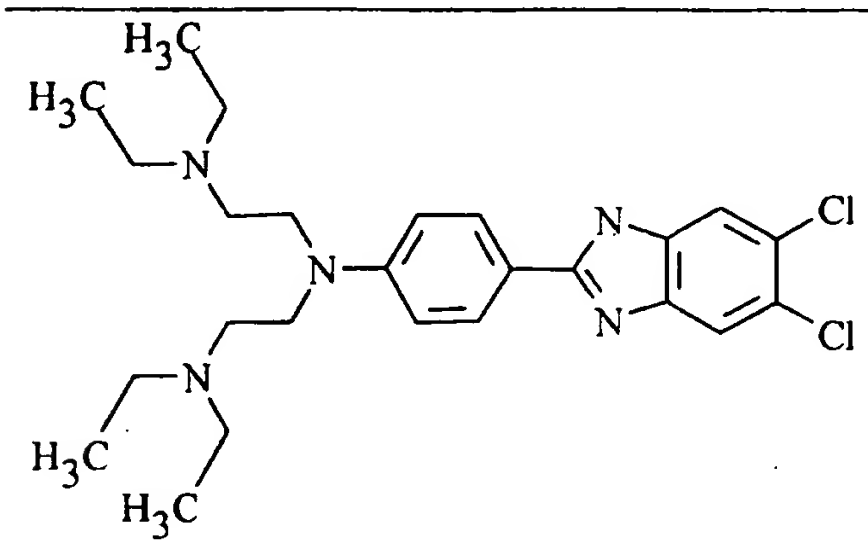
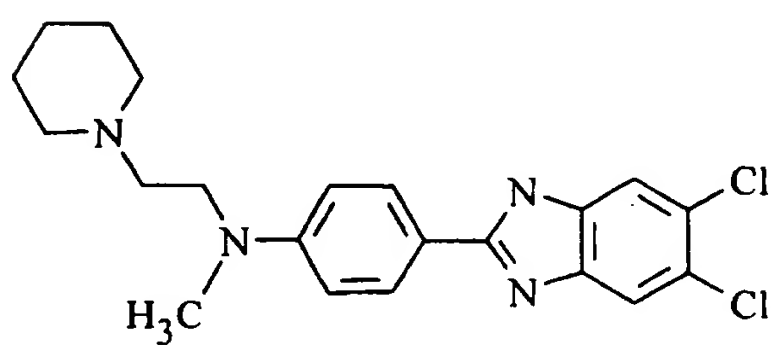
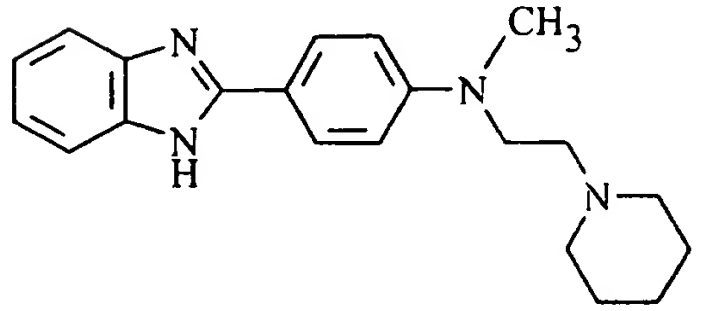
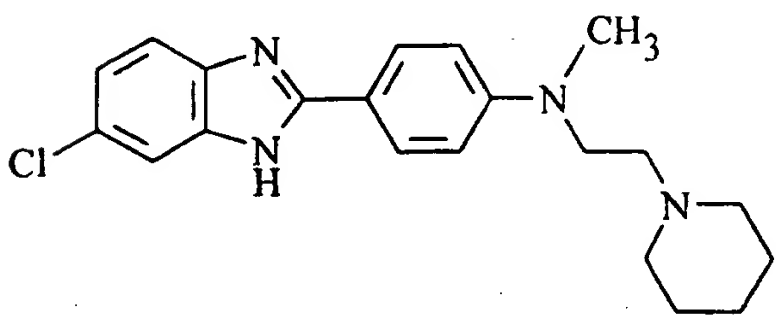
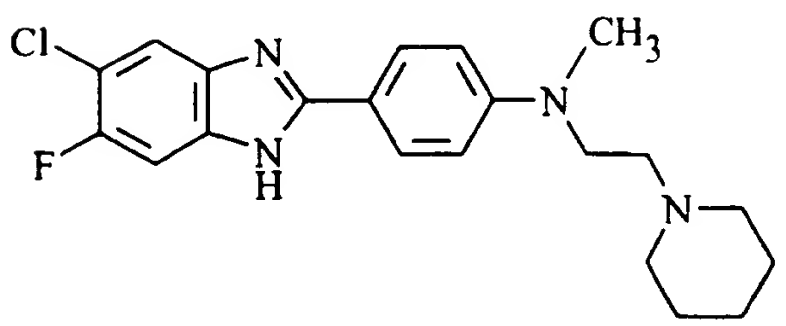
Structure	MCP-1* IC_{50} [μM]
	11.1
	13.4
	10.9
	5.9
	9.6

TABLE 1. Biological Activity: MCP-1 Receptor Binding Assay

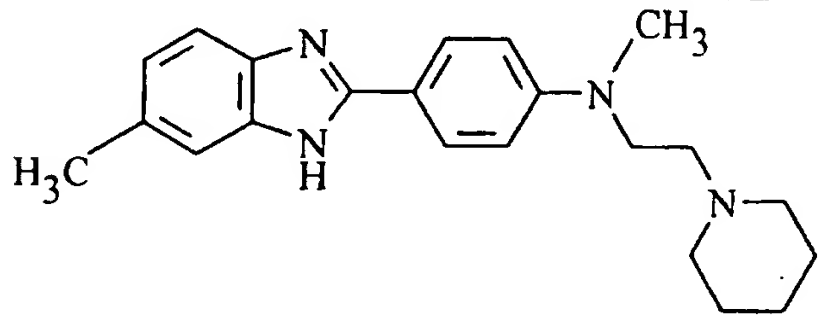
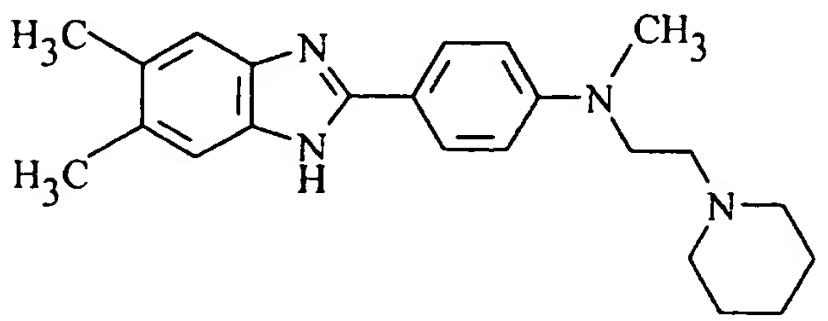
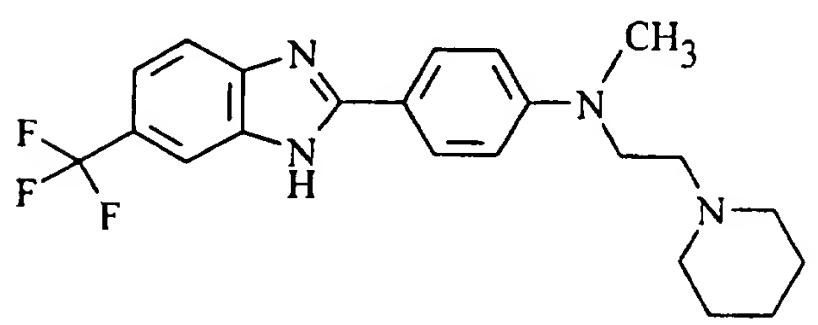
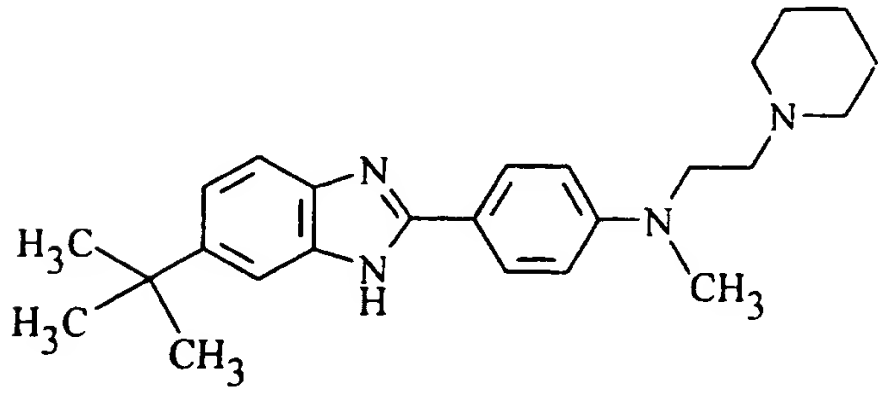
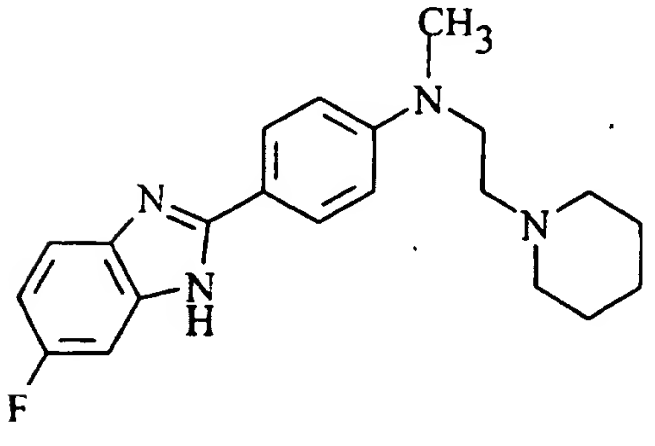
Structure	MCP-1* IC_{50} [μM]
	8.7
	6.3
	15.5
	3.1
	8.6

TABLE 1. Biological Activity: MCP-1 Receptor Binding Assay

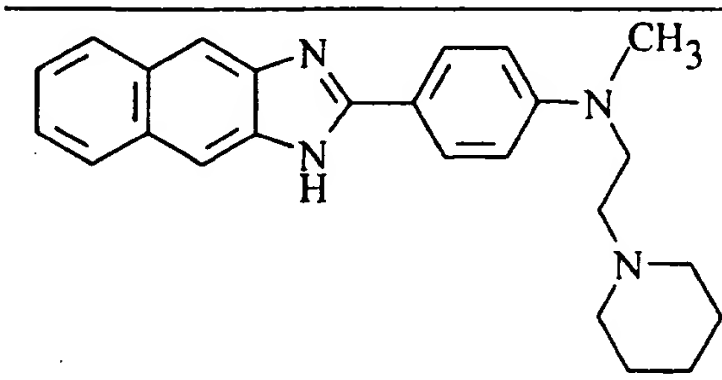
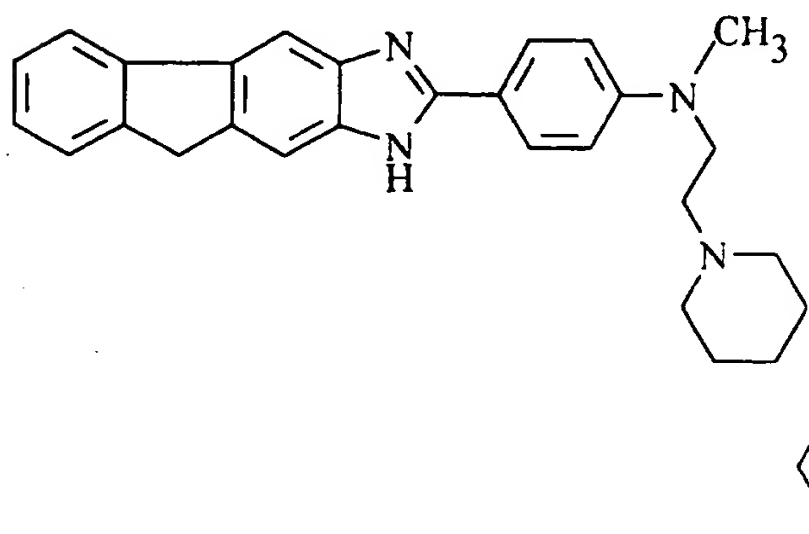
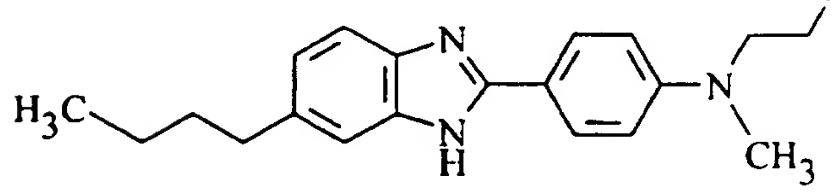
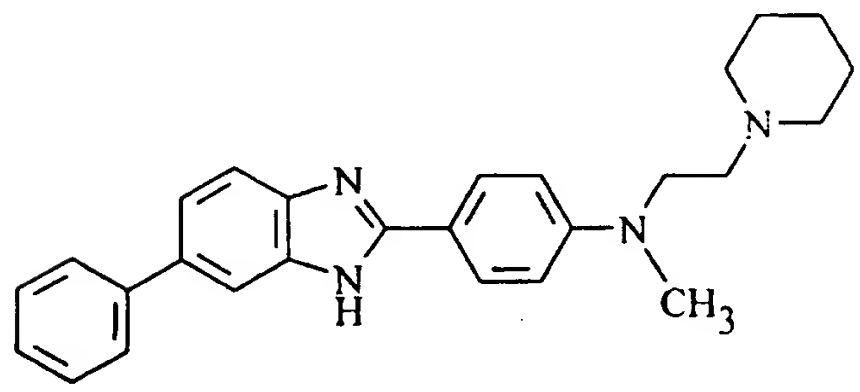
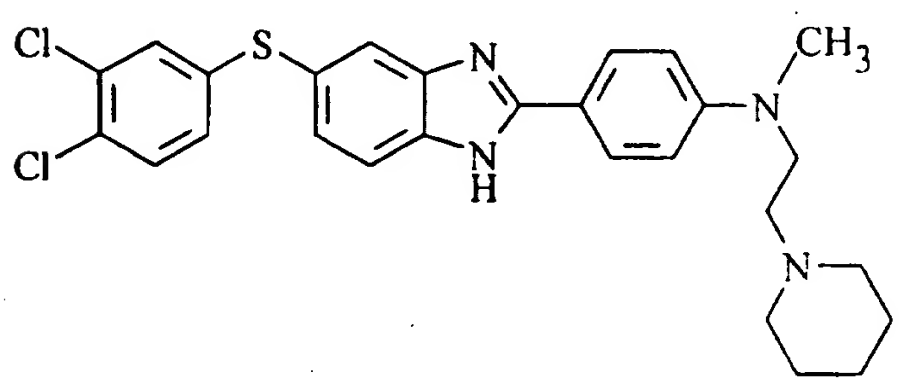
Structure	MCP-1* IC_{50} [μM]
	12.1
	20.7
	11.5
	15.1
	5.1

TABLE 1. Biological Activity: MCP-1 Receptor Binding Assay

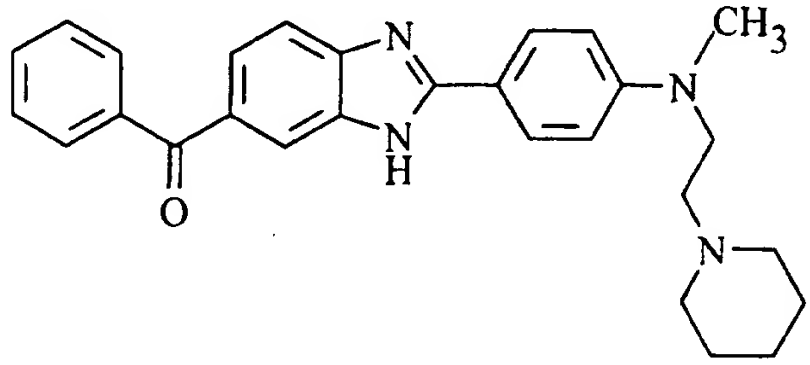
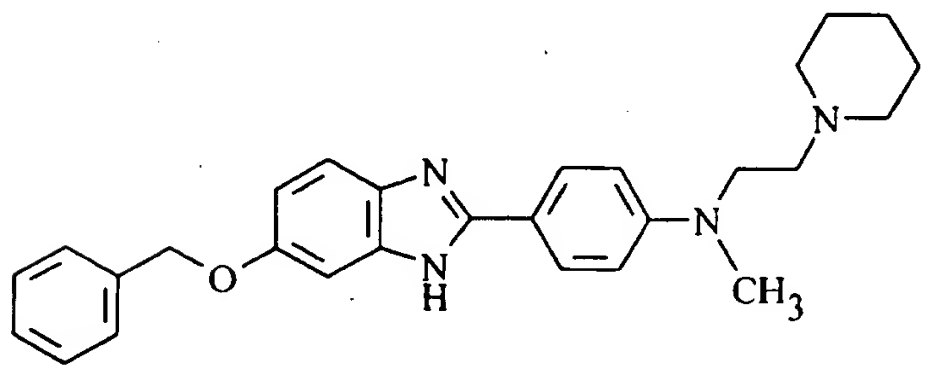
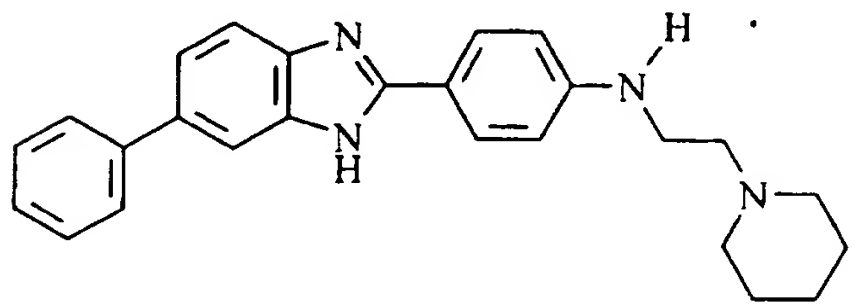
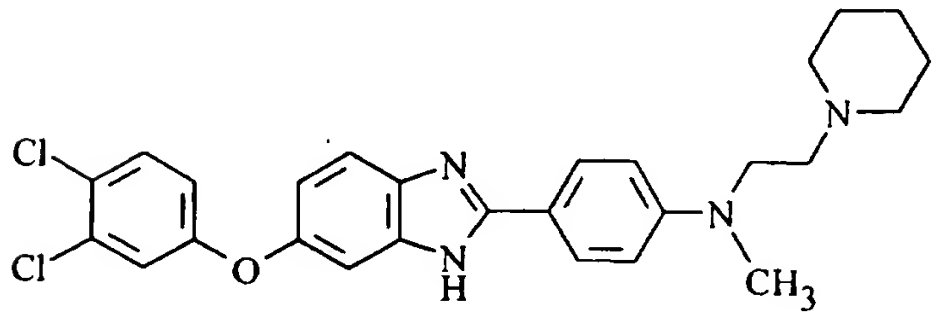
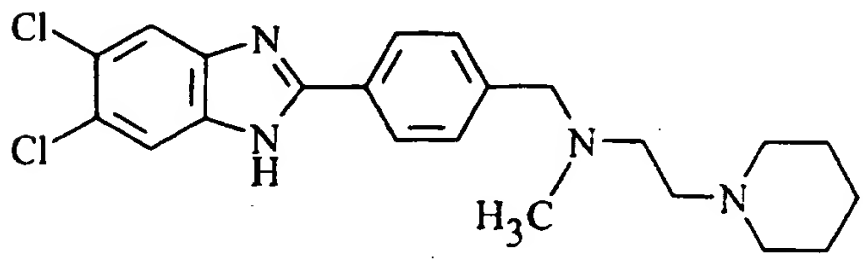
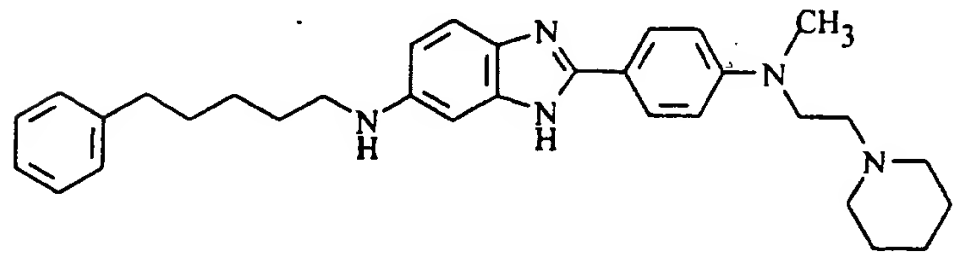
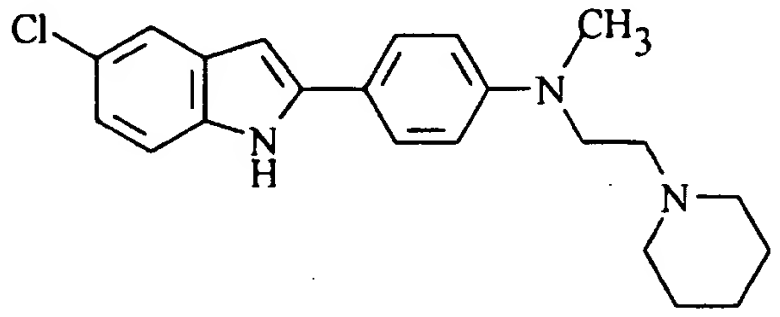
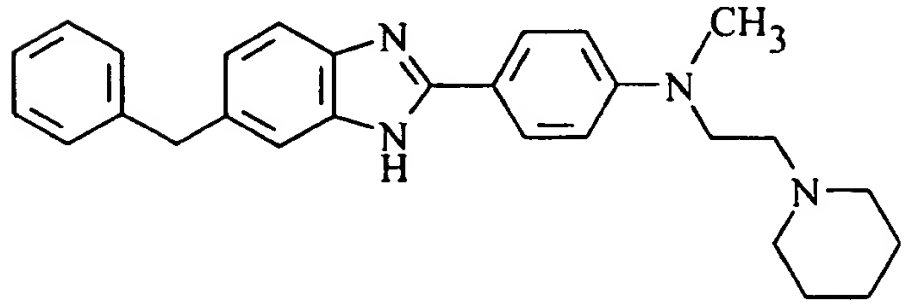
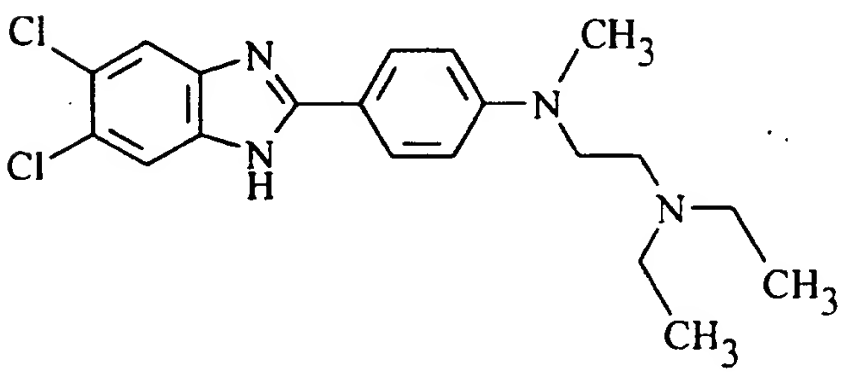
Structure	MCP-1* IC_{50} [μM]
	11.3
	15.4
	11.9
	6.4
	3.2
	6.7

TABLE 1. Biological Activity: MCP-1 Receptor Binding Assay

Structure	MCP-1* IC_{50} [μM]
	9.9
	4.3
	6.8

* Data provided as a range of IC_{50}s from several replications

CD3 - Blast Chemotaxis Assay

Recombinant human MCP-1 was obtained from Peprotech (Rockey Hill, NJ). T lymphocyte blast cells (CD3-Blasts) were generated by standard protocols (Coligan, J.E., A.M. Kruisbeek, D.H. Macgulies, E.M. Shevach, and W. Strober, editors. 1992. Current Protocols in Immunology. John Wiley and Sons, New York 7.1.2, 7.10.1-7.10.10). Briefly, human peripheral blood mononuclear cells (PBMC) were isolated from heparinized venous blood by Percoll density gradient centrifugation (d=1.088) at room temperature. RBCs were removed by hypotonic lysis or dextran sedimentation. Blast cells were generated by incubating 2×10^6 PBMC in 24-well tissue culture plates that were coated with 2.5 μg of an anti-CD3 monoclonal antibody (identified as TR66, a gift from Dr. A. Lanzivecchia; similar

monoclonal antibody is HIT3a, from Parmingen #30111A) at 37°C for 48 to 72 hours, and then transferring 12 wells to T25 or T75 flasks with RPMI (Roswell Park Memorial Institute 1640, a growth cell medium available from Gibco/RBL, Inc., N.Y.) + 10% FCS (fetal calf serum) + 50 units/ml IL-2. The cells are expanded and cultured for up to 3 weeks. CD3-Blast chemotaxis was assessed no sooner than 3 to 4 days after transfer to the IL-2 containing medium using a modification of a transendothelial migration assay (Carr. M.W., S.J. Roth, B. Luther, S.S. Rose, and T.A. Springer. 1994. Monocyte chemoattractant protein 1 acts as a T-lymphocyte chemoattractant. Proc. Natl. Acad. Sci. USA 91:3652-6). The endothelial cells used for this assay were the endothelial cell line ECV304. (ECV304 was from the European Collection of Animal Cell Cultures, Porton Downs, UK, assession #92091712). Endothelial cells were cultured on 6.5 mm diameter Transwell culture inserts (Costar) with a 3.0 mm pore size. Culture media for ECV304 cells consisted of M199 (a cell culture medium from Gibco BRL, Inc., Gaithersburg, MD) + 10% FCS (fetal calf serum from Gibco BRL, Inc.), L-glutamine, and antibiotics (the penicillin concentration was 50 U/mL, and the streptomycin concentration was 50 µg/mL; both from Gibco, N.Y.). Assay media consisted of equal parts RPMI 1640 and M199, with 0.5% BSA (bovine serum albumin or simply RPMI 1640 with 0.5% BSA). Twenty four hours before the assay, 2×10^5 ECV304 cells were plated onto each insert of the 24 well chemotaxis plate and incubated at 37°C. MCP-1 (About 10 nM diluted in assay medium) with or without compounds, was added to the wells of a 24-well tissue culture plate in a final volume of 600 mL. Endothelial coated Transwells were inserted into each well and 10^6 CD3-blasts were added to the top chamber in a final volume of 100 mL, with or without compounds. The plate was then incubated at 37°C in 5% CO_2 95% air for approximately 1 hour. The cells that had migrated to the bottom chamber were enumerated using flow cytometry. 500 mL of the cell suspension from the lower chamber was placed in a tube, and relative cell counts were obtained by acquiring events for a set time period of 30 seconds. This counting method was found to be highly reproducible, and enabled gating on the leukocytes and the exclusion of debris or other cells.

Background migration was determined by counting cells that migrated in the absence of MCP-1 in the lower chamber. This background migration of cells per 30 second count was subtracted from the migration to MCP-1 to obtain specific migration. The percent inhibition by compounds of directed migration was determined by the following formula:

$$1 - \left[\frac{Mc}{Mo}\right]$$

where Mc = the specific migration in the presence of compound and Mo = the specific migration in the absence of compound.

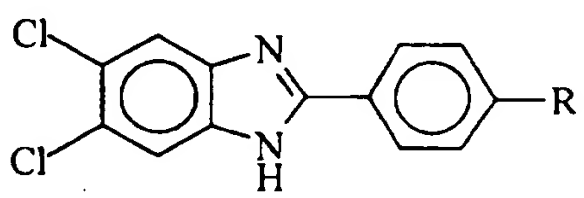


TABLE II CD3 Chemotaxis Assay

Example	R	% Inhibition of Chemotaxis at 10 μM
1	$N(C_2H_4NEt_2)_2$	62-142*
2	$-N(CH_3)$-2-[N-Piperdine]Ethyl	100, 102**
3	$-N(CH_3)(C_2H_4NEt_2)$	95, 102**

* Data presented as a range from several replications
** Data from two separate experiments

Streptococcal Cell Wall Arthritis

Streptococcal cell wall (SCW) arthritis is induced in female Lewis rats (200 g). To induce the subacute, transient arthritic response, a highly refined preparation of streptococcal cell walls (100P, Lee Laboratories, Grayson, Georgia) is injected into the ankle joints of female Lewis rats (6 μl/rat in Dulbecco's PBS).

Twenty one days later, the animals are given an IV booster of SCW at a dose of 100 μg/rat in 0.25 mL of Dulbecco's PBS. Vehicle (0.5% hydroxypropylmethylcellulose and 0.2% Tween 80, 10 mL/kg) or test compounds suspended in vehicle is given one hour before the IV challenge with SCW and daily thereafter for 3 additional days. Paw volume is measured daily by mercury plethysmography. Swelling was determined by comparing paw volume at the various timepoints with an initial paw volume measurement for each rat. Percent inhibition of swelling in compound-treated rats is determined in comparison with swelling in rats treated with vehicle. Statistical power is calculated using an analysis of covariance with a contrast mean comparison test (n=5-10 per experimental group).

Glucan Vasculitis Model

Pulmonary granulomatous vasculitis was induced in anesthetized, 150-20 g male Lewis rats by intravenous infusion of 5 mg glucan. Infusion of particulate yeast cell-wall glucan into rats results in the rapid and synchronous development of angiocentric pulmonary granulomas which are composed almost entirely of monocytes and macrophages. It has been shown previously that MCP-1 mRNA expression and MCP-1 activity in lung lavage fluid rise in association with pulmonary granuloma development, and that granuloma development is markedly attenuated in rats treated with neutralizing concentrations of anti-MCP-1 antibody. This suggests that MCP-1 plays a pivotal role in the pathogenesis of glucan-induced granulomatous vasculitis. For these studies, compound was given by oral gavage at the indicated doses one hour prior to, and then twenty-four and forty-eight hours after glucan infusion. The rats were sacrificed seventy-two hours after the glucan infusion. At the time of sacrifice, the lungs were lavaged with 6.0 mLs. PBS/EDTA. Total cell counts in the recovered lavage fluid were obtained on a coulter counter, and cytocentrifuge preparations were prepared for differential cell counts. Following the lavage, the lungs were fixed with 10% neutral buffered formalin for routine processing and histological assessment of pulmonary vasculitis. The test results are shown in Figure 1 for Example 1 compound.

Inhibition of T Cell Recruitment to Rat Skin Inflammatory Sites by Compound 1

Method of Evaluation

Inbred, approximately 200 g, male Lewis rats were used in all experiments. Cutaneous delayed hypersensitivity (DHR) was induced as previously described (1). Briefly, rats were sensitized to KLH (Sigma Chemical Co., St. Louis, MO) by administering 50 µg KLH in 0.1 mL complete Freund's adjuvant (CFA; Sigma Chemical Co.) into each of 4 subcutaneous sites. After 14 days, DHR was elicited by the challenge of 5 µg KLH in PBS into multiple intradermal sites on the back. Analysis was performed 24 hours after antigen challenge. For each experiment, there were at least three groups of animals of at least four animals in each group. One group of nonsensitized, naive animals was used as a negative control and received vehicle alone (consisting of 0.5% hydroxypropylmethylcellulose/0.2% Tween 80 in water) *per os* at the time of challenge. As positive controls, one group of sensitized animals received alone *per os* at the time of KLH challenge. A third group consisted of sensitized animals that received compound suspended in vehicle *per os* at the time of KLH challenge.

T cell recruitment at sites of DHR was quantified using methods previously described (1-4). Briefly, rat T cells were isolated from spleen of naive adult Lewis rats by mincing the splenic tissue, removing the red cells by hypotonic lysis, and passing the cells through a nylon wool column. The cells in the effluent were highly purified (>95%) rat T cells as assessed by anti-rat CD3 (monoclonal antibody KT3, Biosource International, Camarillo, CA) immunoreactivity by flow cytometry. Radiolabeling was performed by suspending 5 X 10^7 T cells in 0.5 mL RPMI 1640 medium with 7.5 µCi ^{111}In-oxiquinoline (Amersham Corp., Arlington Hgts, IL) for 20 min at room temperature so that 2 X 10^7 T cells yielded approximately 0.5 - 2 X 10^6 cpm of γ activity. The cells were then washed twice, resuspended in RPMI 1640 plus 10% normal rat serum, and 2 X 10^7 labeled T cells/200 gm body weight rat were injected intravenously at the time of KLH intradermal challenge. Skin challenge sites (8 mm in diameter) were counted on a γ counter 24 hours after injection of radiolabeled T cells. Lung, liver, and spleen were also collected and counted as comparative indices for evaluation of input.

Statistical significance was determined using a paired Student's *t*-test. Differences between means were considered significant when $P<0.05$.

Results

When administered once *per os* at the time of antigen challenge, Compound #1 inhibited the recruitment of ^{111}In-labeled rat T cells to skin DHR sites in a dose-dependent fashion (Fig. 2).

References

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2. Issekutz, T.B. 1991. Inhibition of in vivo lymphocyte migration to inflammation and homing too lymphoid tissues by the TA-2 monoclonal antibody: a likely role for VLA-4 in vivo. *J. Immunol.* 147:4178-4184.

3. Issekutz, T.B. and A.C. Issekutz. 1991. T lymphocyte migration to arthritic joints and dermal inflammation in the rat: differing migration patterns and the involvement of VLA-4. *Clin. Immunol. Immunopathol.* 61:436-447.

4. Issekutz, T.B. 1993. Dual inhibition of VLA-4 and LFA-1 maximally inhibits cutaneous delayed-type hypersensitivity-induced inflammation. *Am. J. Pathol.* 143:1286-1293.

The compounds of the present invention can be prepared and administered in a wide variety of routes of administration such as parenteral, oral, topical, rectal, inhalation and the like. Formulations will vary according to the route of administration selected. Examples are oral and parenteral dosage forms. Thus, the compounds of the present invention can be administered by injection, that is, intravenously, intramuscularly, intra-cutaneously, subcutaneously, intraduodenally, or intra-peritoneally. Also, the compounds of the present invention can be administered by inhalation, for example, intranasally. Additionally, the compounds of the present invention can be administered

transdermally. The following dosage forms may comprise as the active component, a compound of Formula I or a corresponding pharmaceutically acceptable salt of a compound of Formula I.

For preparing pharmaceutical compositions from the compounds of the present invention, pharmaceutically acceptable carriers can be either solid or liquid. Solid form preparations include powders, tablets, pills, capsules, cachets, suppositories, and dispersible granules. A solid carrier can be one or more substances which may also act as diluents, flavoring agents, binders, preservatives, tablet disintegrating agents, or an encapsulating material.

In powders, the carrier can be a finely divided solid which is in a mixture with the finely divided active component.

In tablets, the active component can be mixed with the carrier having the necessary binding properties in suitable proportions and compacted in the shape and size desired.

The powders and tablets preferably contain from 5% or 10% to about 70% of the active compound. Suitable carriers are magnesium carbonate, magnesium stearate, talc, sugar, lactose, pectin, dextrin, starch, gelatin, tragacanth, methylcellulose, sodium carboxymethylcellulose, a low melting wax, cocoa butter, and the like. The term "preparation" is intended to include the formulation of the active compound with encapsulating material as a carrier providing a capsule in which the active component with or without other carriers, is surrounded by a carrier, which is thus in association with it. Similarly, cachets and lozenges are included. Tablets, powders, capsules, pills, cachets, and lozenges can be used as solid dosage forms suitable for oral administration.

For preparing suppositories, a low melting wax, such as a mixture of fatty acid glycerides or cocoa butter, is first melted and the active component can be dispersed homogeneously therein, as by stirring. The molten homogenous mixture can be then poured into convenient sized molds, allowed to cool, and thereby to solidify.

Liquid form preparations include solutions, suspensions, and emulsions, for example, water or water propylene glycol solutions. For parenteral injection,

liquid preparations can be formulated in solution in a pharmaceutically acceptable carrier, such as, aqueous polyethylene glycol solution.

Aqueous solutions suitable for oral use can be prepared by dissolving the active component in water and adding suitable colorants, flavors, stabilizing, and thickening agents as desired.

Aqueous suspensions suitable for oral use can be made by dispersing the finely divided active component in water or another suitable carrier with viscous material, such as natural or synthetic gums, resins, methylcellulose, sodium carboxymethylcellulose, and other well-known suspending agents.

Also included are solid form preparations which are intended to be converted, shortly before use, to liquid form preparations for oral administration. Such liquid forms include solutions, suspensions, and emulsions. These preparations may contain, in addition to the active component, colorants, flavors, stabilizers, buffers, artificial and natural sweeteners, dispersants, thickeners, solubilizing agents, and the like.

The pharmaceutical preparation is preferably in unit dosage form. In such form the preparation is subdivided into unit doses containing appropriate quantities of the active component. The unit dosage form can be a packaged preparation, the package containing discrete quantities of preparation, such as packeted tablets, capsules, and powders in vials or ampoules. Also, the unit dosage form can be a capsule, tablet, cachet, or lozenge itself, or it can be the appropriate number of any of these in packaged form.

The quantity of active component in a unit dose preparation may be varied or adjusted for example from about 0.1 mg to 200 mg, preferably about 0.5 mg to 100 mg according to the particular application and the potency of the active component. The composition can, if desired, also contain other compatible therapeutic agents.

In therapeutic use as agents for the treatment of inflammatory diseases, inflammatory diseases, atherosclerosis, restenosis, and immune disorders such as arthritis and transplant rejection, the compounds utilized in the pharmaceutical methods of this invention can be administered at an initial dosage of about 0.01 mg to about 200 mg/kg daily. A daily dose range of about 0.01 mg to about

50 mg/kg is preferred. The dosages, however, may be varied depending upon the requirements of the patient, the severity of the condition being treated, and the compound being employed. Determination of the proper dosage for a particular situation is within the skill of the art. Generally, treatment is initiated with smaller dosages which are less than the optimum dose of the compound. Thereafter, the dosage is increased by small increments until the optimum effect under the circumstances is reached. For convenience, the total daily dosage may be divided and administered in portions during the day, if desired.

The ACAT inhibitors, HMG-CoA reductase inhibitors, lipid regulators, and bile acid sequestrants utilized in the second embodiment of the present invention can be used in standard dosage amounts known in the art.

As further exemplification of the invention listed below are preferred embodiments wherein all parts are parts by weight and all temperatures are degrees Centigrade unless otherwise indicated.

Example 1 (Compound 1)

Step A: Preparation of 4[bis-(2-diethylamino-ethyl)-amino]benzaldehyde.

4-Fluorobenzaldehyde (9.8 g, 80.0 mmol), 1,1,7,7,-tetraethyldiethylene diamine (20 g, 92.8 mmol) and K_2CO_3 (12.8 g, 92.8 mmol) in dimethylacetamide (40 mL) are heated to 120°C with vigorous stirring for three days. The reaction mixture is cooled, diluted with water (200 mL) and extracted with EtOAc (3 x 200 mL). The organic layer is dried (magnesium sulfate) and concentrated. The product is chromatographed on silica gel eluting with 0.5% NH_4OH:5.0% MeOH:94.5% CH_2Cl_2 to give 10.2 g of a brown oil.

Step B: Preparation of N-[4-(5,6-dichloro-1H-benzimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N, N-diethyl-ethane-1,2-diamine.

4-[Bis-[2-diethylamino-ethyl)-amino]-benzaldehyde (10 g, 31.3 mmol) and sodium bisulfite ($NaHSO_3$) (6.76 g) in methanol (300 mL) are heated to reflux for 4 hours. 4,5-Dichlorophenylenediamine (5.54 g, 31.3 mmol) is added and the reaction mixture is refluxed for 18 hours. The reaction mixture is cooled, filtered

through Celite and concentrated in vacuo. The product is chromatographed on silica gel eluting with 0.4% NH_4OH:4.0% MeOH:95.6% CH_2Cl_2 followed by recrystallization from hot 50% EtOH:50% H_2O to give 8.98g of peach colored needles; mp 129-132°C.

Compounds 2-9 were prepared in a similar fashion.

Example 10

Step A: Preparation of 4[methyl-(2-piperidin-1-yl-ethyl-amino]acetophenone.

4′-Fluoroacetophenone (1.5 g, 10.86 mmol), N-methyl-1-piperidineethanamine (1.54 g, 10.86 mmol) and K_2CO_3 (1.80 g, 13.0 mmol) in dimethylacetamide (5 mL) are heated to 100°C with vigorous stirring for 3 days. The reaction mixture is cooled, diluted with water (50 mL), and extracted with EtOAc (3 × 50 mL). The organic layer is dried (magnesium sulfate) and concentrated. The product is chromatographed on silica gel eluting with 0.3% NH_4OH:2.7% MeOH:97% CH_2Cl_2 to give 1.95 g of a brown oil.

Step B: Preparation of [4-(5-Chloro-3H-indol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine.

4[Methyl-(2-piperidin-1-yl-ethyl-amino]acetophenone (1.8 g, 6.91 mmol) and 4-chlorophenylhydrazine hydrochloride are mixed with polyphosphoric acid (15 mL) and heated to 100°C for 15 minutes. The reaction mixture is cooled, diluted with water (300 mL), basified with solid NaOH to pH 10 and extracted with CH_2Cl_2. The organic layer is dried (magnesium sulfate) and concentrated. The product is chromatographed on silica gel eluting with 3% MeOH:97% CH_2Cl_2 to give 0.611 g of a black solid. Recrystallization from hot EtOH and water gave 0.400 g of the product as a white solid; mp 192°C.

Example 2

N-[4-(5,6-dichloro-1H-benzimidazol-2-yl)-phenyl]-N-methyl-N-(2-piperidin-1-yl-ethyl)-amine mp 165-167°C

Example 3

N-[4-(5,6-dichloro-1H-benzimidazol-2-yl)-phenyl]-N-(2-diethylaminoethyl)-N-methyl, N-diethyl-ethane-1,2-diamine mp 124-128°C

Example 4

[4-[6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine mp 196°C

Example 5

[4-(5-Chloro-6-fluoro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine mp 167-168°C

Example 6

Methyl-[4-(6-methyl-1H-benzoimidazol-2-yl)-phenyl]-(2-piperidin-1-yl-ethyl)-amine mp 165°C

Example 7

[4-(5,6-Dimethyl-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine mp 194-196°C

Example 8

[4-(6,7-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine mp 164°C

Example 9

[4-(6-methoxy-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine dihydrochloride mp 273°C

Example 10

[4-(5-Chloro-3H-indol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine mp 192°C

Some preferred compounds are:

N-[4-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[4-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(1H-Benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(1H-Benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine, mp 190-191°C

N-[4-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[3-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(1H-Benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(1H-Benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[3-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[2-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(1H-Benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(1H-Benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[2-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(1H-Benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(1-methyl-1H-benzoimidazol-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{2-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-benzoimidazol-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(1-methyl-1H-benzoimidazol-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-benzoimidazol-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(1-methyl-1H-benzoimidazol-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-benzoimidazol-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[2-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(1H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[2-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(1H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[2-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(3H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[2-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(3H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[2-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[3-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(1H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[3-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(1H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[3-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(3H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[3-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(3H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[3-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[4-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(1H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[4-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(1H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[4-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(3H-Imidazo[4,5-c]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N,N-Diethyl-N′-[4-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(3H-Imidazo[4,5-b]pyridin-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N-[4-(3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-N′,N′-dimethyl-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[4-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[4-(7H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[3-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[3-(7H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[2-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[2-(7H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[2-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[2-(9H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[2-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[3-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[3-(9H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[3-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N,N-Diethyl-N′-(2-piperidin-1-yl-ethyl)-N′-[4-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

Methyl-(2-piperidin-1-yl-ethyl)-[4-(9H-purin-8-yl)-phenyl]-amine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Dimethylamino-ethyl)-N′,N′-dimethyl-N-[4-(9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(1-methyl-1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{2-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-b]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(1-methyl-1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-b]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(1-methyl-1H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-b]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(1-methyl-1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{2-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(1-methyl-1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(1-methyl-1H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-1-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(3-methyl-3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{2-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-3-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(3-methyl-3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-3-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(3-methyl-3H-imidazo[4,5-c]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(2-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-imidazo[4,5-c]pyridin-3-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[2-(3-methyl-3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(3-methyl-3H-imidazo[4,5-b]pyridin-2-yl)-phenyl]-ethane-1,2-diamine

1-(8-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-purin-7-yl)-ethanone

N-(2-Diethylamino-ethyl)-N',N'-diethyl-N-[4-(7-methyl-7H-purin-8-yl)-phenyl]-ethane-1,2-diamine

1-(8-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-purin-7-yl)-ethanone

N-(2-Diethylamino-ethyl)-N',N'-diethyl-N-[2-(9-methyl-9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

1-(8-{2-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-purin-9-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[3-(9-methyl-9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

1-(8-{3-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-purin-9-yl)-ethanone

N-(2-Diethylamino-ethyl)-N′,N′-diethyl-N-[4-(9-methyl-9H-purin-8-yl)-phenyl]-ethane-1,2-diamine

1-(8-{4-[Bis-(2-diethylamino-ethyl)-amino]-phenyl}-purin-9-yl)-ethanone

N-[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(5-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine, mp 156°C

N-[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[2-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine

N-[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine

N-[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[3-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine, mp 129-132°C

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N′,N′-diethyl-N-(2-piperidin-1-yl-ethyl)-ethane-1,2-diamine

[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine, mp 160-163°C

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine; and

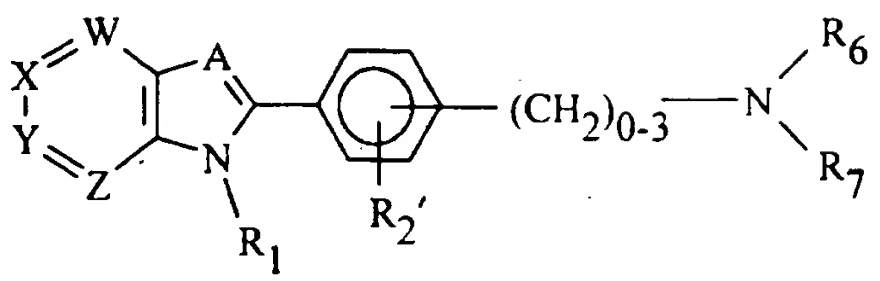
N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-dimethylamino-ethyl)-N′,N′-dimethyl-ethane-1,2-diamine.

While the forms of the invention herein disclosed constitute presently preferred embodiments, many others are possible. It is not intended herein to mention all of the possible equivalent forms or ramifications of the invention. It is understood that the terms used herein are merely descriptive rather than limiting and that various changes may be made without departing from the spirit or scope of the invention.

CLAIMS

What is claimed is:

1. A compound of Formula I



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N,

no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} akyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ where p is an integer of from 0 to 2,

$-(CH_2)_mOR$,

$-(CH_2)_mCOOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$,

$-CF_3$,

-benzyl, or

phenyl wherein benzyl or phenyl is optionally substituted with one or two substituents each independently selected from alkyl, halogen, hydrogen, hydroxy, or alkoxy;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl;

when X and Y are substituted by alkyl, they can be joined to form a ring fused at X and Y;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R'_2 is:

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ wherein p is an integer of from 0 to 2,

$-(CH_2)_mOR_1$-CH_2COOR,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms, or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents, or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents;

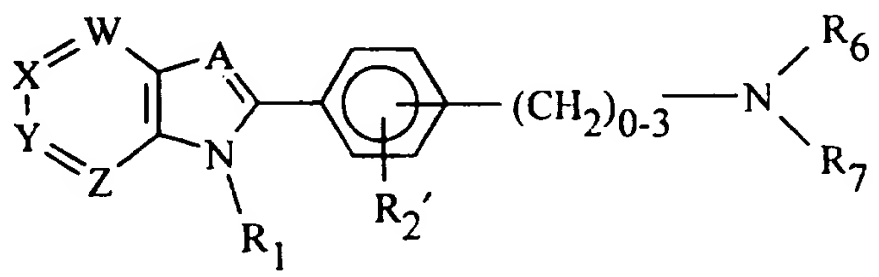
t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

2. The compound of Claim 1 wherein R_1 is hydrogen.

3. The compound of Claim 1 wherein R_1 and R_2' are hydrogen.

4. A method for the treatment of inflammatory disease or condition, atherosclerosis, restenosis, chronic or acute immune disorders, or transplant rejection in a mammal in need thereof comprising administering to such mammal an effective amount of a compound of Formula I



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N;

no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms;

$-S(O)_pR$ where p is an integer from 0 to 2;

$-(CH_2)_mOR$,

$-(CH_2)_mCOOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

benzyl, or

phenyl wherein benzyl or phenyl is optionally substituted with one or two substituents each independently selected from alkyl, halogen, hydrogen, hydroxy, or alkoxy;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl;

R'_2 is:

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ wherein p is an integer of from 0 to 2,

$-(CH_2)_mOR_1-(CH_2)COOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms, or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents, or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substitutents;

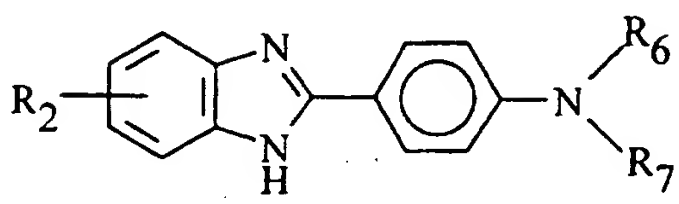
t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

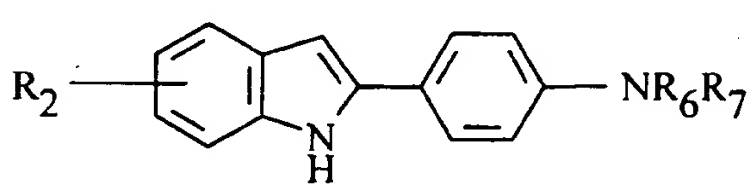
5. The method of Claim 4 wherein R_2, R_3, R_4, and R_5 are hydrogen.

6. The method of Claim 4 wherein R_1 is hydrogen.

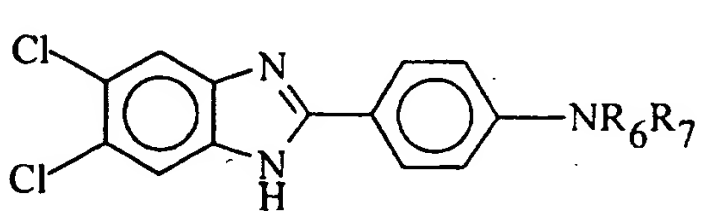
7. The method of Claim 4 comprising the compound recited below:



8. The method of Claim 4 comprising the compound recited below:



9. The method of Claim 4 comprising the compound recited below:



10. The method of Claim 4 wherein R_2, R_3, R_4 or R_5, can be independently

OH,

alkoxy,

halogen,

$-NH_2$,

-dialkylamino,

$-NO_2$,

$-CF_3$,

-SH, or

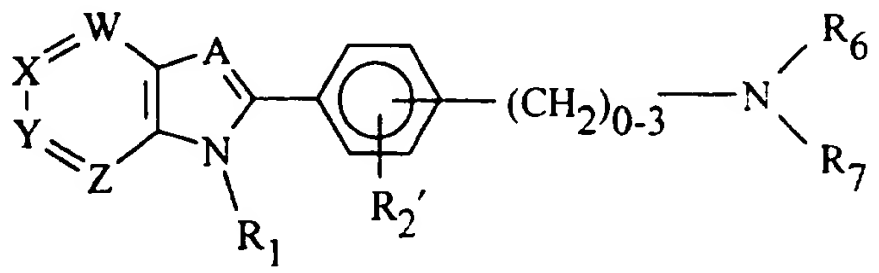
-S-alkyl.

11. The method of Claim 4 wherein R_1 is alkyl.

12. The method of Claim 4 wherein the disease or condition may be any one of the following: arthritis, rheumatoid arthritis, osteoarthritis inflammatory bowel diseases, Crohn's disease, ulcerative colitis, multiple sclerosis, idiopathic pulmonary fibrosis, graft rejection, allograft rejection, allergic hypersensitivity disorders, asthma and allergic rhinitis, psoriasis, chronic contact dermatitis, sarcoidosis, dermatomyositis, skin phemphigoid, pemphigus vulgaris, p. foliacious, p. erythematosus, glomerulonephritides, vasculitides including necrotizing, cutaneous and hypersensitivity vasculitis; hepatitis, diabetes, systemic lupus erythematosus, myasthenia gravis, dermatitis, eczema, atopic dermatitis, allergic contact dermatitis, urticaria, and reparfusion injury.

13. A pharmaceutical composition for the treatment of inflammation, atherosclerosis, restenosis, immune disorders, and transplant rejection in a mammal in need thereof comprising administering to such mammal a therapeutically effective amount of a compound according to Claim 1 in admixture with a pharmaceutically acceptable excipient, diluent, or carrier.

14. A method for the treatment of atherosclerosis in a mammal in need thereof comprising administering to such mammal an effective amount of a compound of Formula I



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N;

no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently:

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms;

$-S(O)_pR$ where p is an integer from 0 to 2;

$-(CH_2)_mOR$,

$-(CH_2)_mCOOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms, or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or N-R_{12};

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents, or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

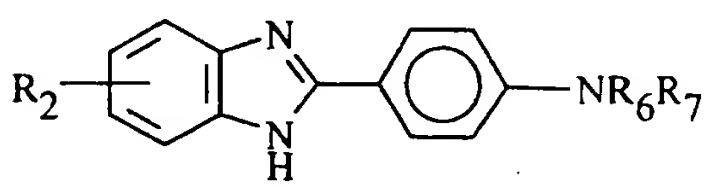
lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents;

t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

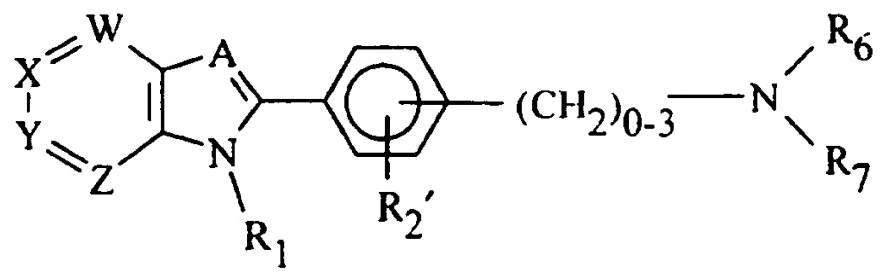
15. The composition of Claim 13 comprising the compound recited below:



wherein X is R_2 and R is $-NR_6R_7$.

16. A pharmaceutical composition for the treatment of atherosclerosis in a mammal in need thereof comprising administering to such mammal a therapeutically effective amount of one or more compounds according to Claim 1 in admixture with a pharmaceutically acceptable excipient, diluent, or carrier.

17. A method of inhibiting the binding of MCP-1 to a receptor thereof in a mammal in need thereof comprising administering to such mammal an effective inhibiting amount of a compound of Formula I



I

wherein A is N or CH;

W, X, Y, and Z can be independently C-R_2, C-R_3, C-R_4, C-R_5, or N, no more than two of W, X, Y, and Z can be N in any one structure,

R_2, R_3, R_4, and R_5 can be independently

H,

C_{1-20} akyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ where p is an integer of from 0 to 2,

$-(CH_2)_mOR$,

$-(CH_2)_mCOOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$,

$-CF_3$,

-benzyl, or

phenyl wherein benzyl or phenyl is optionally substituted with one or two substituents each independently selected from alkyl, halogen, hydrogen, hydroxy, or alkoxy;

m is an integer of from 0 to 4,

R is hydrogen, lower alkyl of from 1-4 carbon atoms, aryl of from 6-10 carbon atoms, or benzyl;

when X and Y are substituted by alkyl, they can be joined to form a ring fused at X and Y;

R_1 can be H, lower alkyl of from 1-4 carbon atoms, or $-(CH_2)_m$-Ph;

R'_2 is:

H,

C_{1-20} alkyl,

halogen,

nitro,

$-SO_2NR_8R_9$,

alkoxy of from 1-4 carbon atoms,

$-S(O)_pR$ wherein p is an integer of from 0 to 2,

$-(CH_2)_mOR_1-CH_2COOR$,

$-(CH_2)_mNR_8R_9$,

$-(CH_2)_mCONR_8R_9$,

$-(CH_2)_mCOR$, or

$-CF_3$;

R_6 is hydrogen or alkyl of from 1-6 carbon atoms or R_7;

R_7 is $(CH_2)_n NR_{10}R_{11}$;

n is an integer from 2 to 6;

R_8 and R_9 can be independently hydrogen, lower alkyl of from 1-4 carbon atoms, or can be taken together to form a ring of from 3-8 atoms having up to one additional heteroatom as O, S, SO_2, or $N-R_{12}$;

R_{10} and R_{11} can independently be lower alkyl,

$-(CH_2)_m$ Ph, unsubstituted or substituted with up to three R_2 substituents, or

R_{10} and R_{11} can be taken together to form a ring of from 3-8 atoms which may contain oxygen or NR_{12};

R_{12} is

hydrogen,

lower alkyl,

$-(CH_2)_t$ Ph, where Ph is phenyl unsubstituted or substituted with up to three R_2 substituents;

t is an integer of from 0 to 2;

or a pharmaceutically acceptable salt thereof.

18. A compound according to Claim 1 and selected from:

Methyl-[4-(1H-naphtho[2,3-d]imidazol-2-yl)-phenyl]-(2-piperidin-1-yl-ethyl)-amine;

[4-(1,9-Dihydro-fluoreno[2,3-d]imidazol-2-yl)-phenyl]-(methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(1H-Benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(6-Chloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(5-Chloro-6-fluoro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

Methyl-[4-(6-methyl-1H-benzoimidazol-2-yl)-phenyl]-(2-piperidin-1-yl-ethyl)-amine;

[4-(5,6-Dimethyl-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(6-Benzyl-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

Methyl-(2-piperidin-1-yl-ethyl)-[4-(6-trifluoromethyl-1H-benzoimidazol-2-yl)-phenyl]-amine;

[4-(6-tert-Butyl-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(6-Butyl-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

Methyl-[4-(6-phenyl-1H-benzoimidazol-2-yl)-phenyl]-(2-piperidin-1-yl-ethyl)-amine;

(2-{4-[Methyl-(2-piperidin-1-yl-ethyl)-amino]-phenyl}-3H-benzoimidazol-5-yl)-phenyl-methanone;

{4-[6-(3,4-Dichloro-phenoxy)-1H-benzoimidazol-2-yl]-phenyl}-methyl-(2-piperidin-1-yl-ethyl)-amine;

{4-[5-(3,4-Dichloro-phenylsulfanyl)-1H-benzoimidazol-2-yl]-phenyl}-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(6-Benzyloxy-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(5,6-Dichloro-1H-benzimidazol-2-yl)-benzyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N′,N′-diethyl-ethane-1,2-diamine;

N-[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-N-(2-diethylamino-ethyl)-N-methyl, N-diethyl-ethane-1,2-diamine;

[4-(5,6-Dichloro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

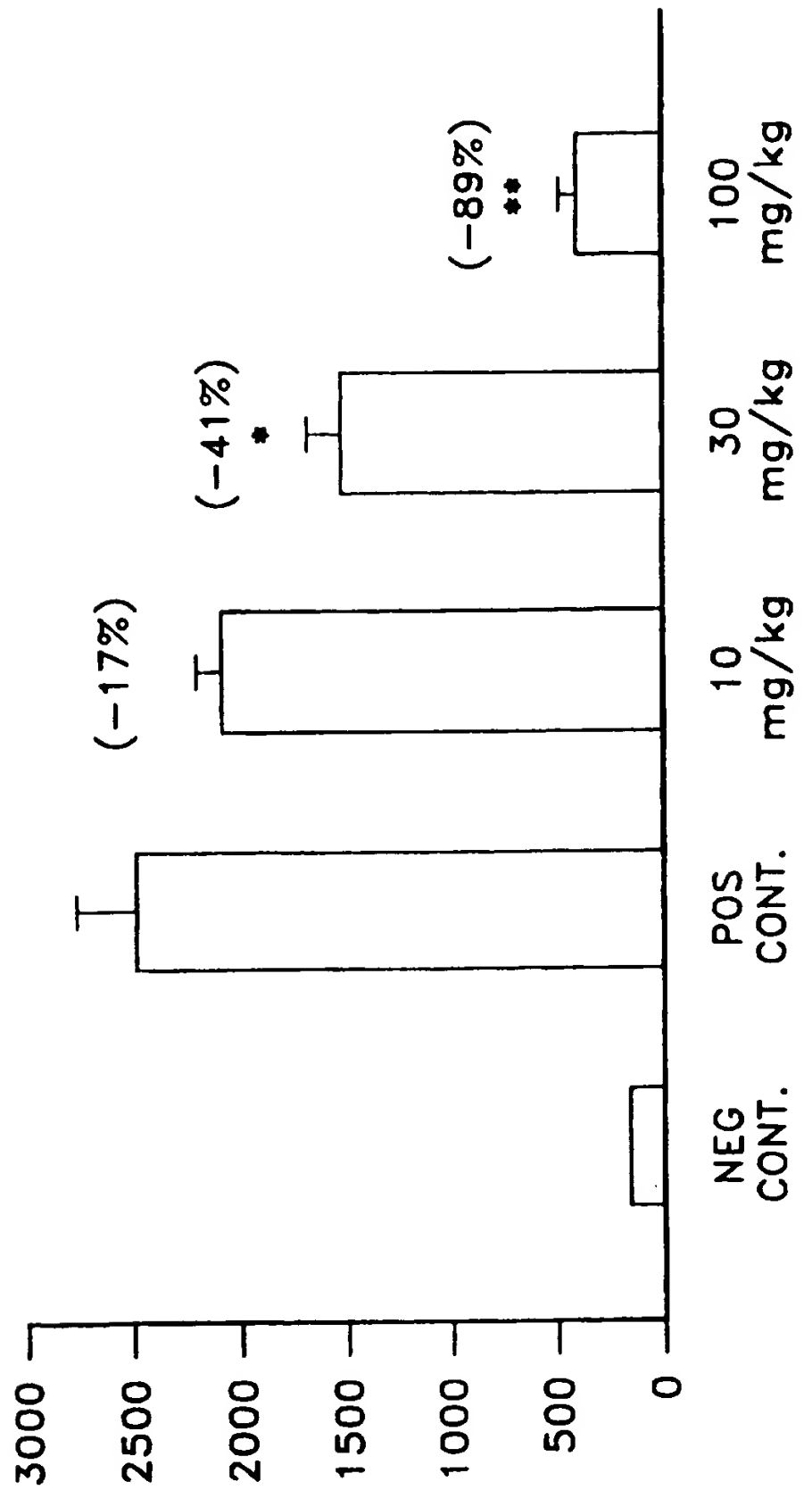
[4-(6-Fluoro-1H-benzoimidazol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine;

[4-(6-Phenyl-1H-benzoimidazol-2-yl)-phenyl]-(2-piperidin-1-yl-ethyl)-amine;

(2-{4-[Methyl-(2-piperidin-1-yl-ethyl)-amino]-phenyl}-3H-benzoimidazol-5-yl)-(5-phenyl-pentyl)-amine; and

[4-(5-Chloro-3H-indol-2-yl)-phenyl]-methyl-(2-piperidin-1-yl-ethyl)-amine.

FIG—1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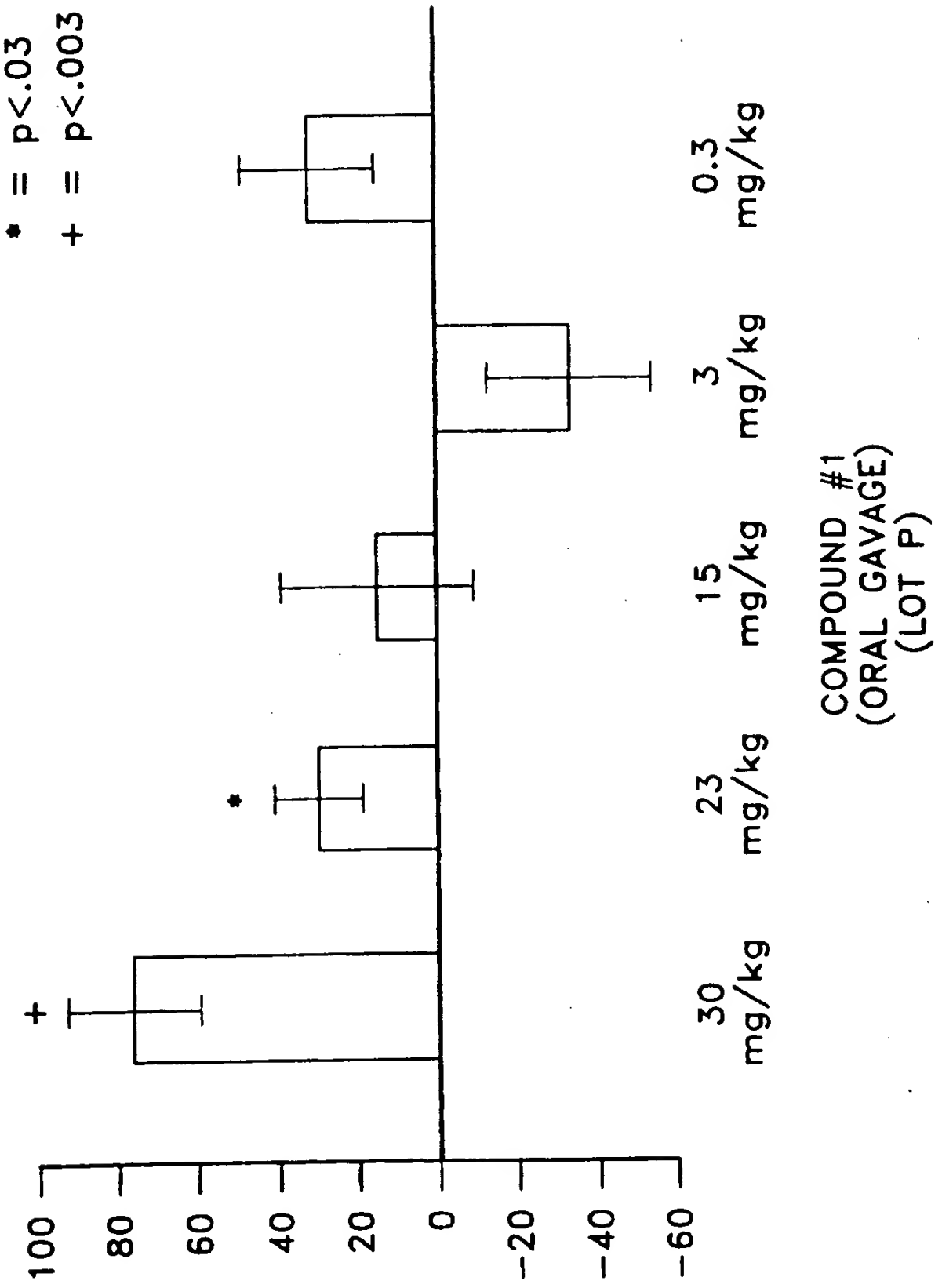
3000
2500
2000
1500
1000
500
0
NEG CONT.
POS CONT.
10 mg/kg
30 mg/kg
100 mg/kg
(−17%)
(−41%)
*
(−89%)
**

FIG-2


* = p<.03
+ = p<.003
PERCENT INHIBITION
100
80
60
40
20
0
-20
-40
-60
+
*
30 mg/kg
23 mg/kg
15 mg/kg
3 mg/kg
0.3 mg/kg
COMPOUND #1
(ORAL GAVAGE)
(LOT P)

INTERNATIONAL SEARCH REPORT

Intern. ial Application No
PCT/US 97/13870

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07D235/18 A61K31/415 C07D401/12 A61K31/445 C07D471/04
C07D473/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C07D A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 06831 A (CANCER SOC AUCKLAND DIV NZ INC ;CIRCADIAN PHARM AU PTY LTD (AU); D) 7 March 1996 see claim 1 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 November 1997	10. 12. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gettins, M

INTERNATIONAL SEARCH REPORT

Interr. nal Application No
PCT/US 97/13870

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9606831 A	07-03-96	AU 3247595 A	22-03-96
		EP 0777656 A	11-06-97